Electrical Safety Program

Overview

- Describe identified hazards
- Ensure personnel have required PPE while working on energized circuits
- Identify common hazards with electrical equipment
- Submit work request to address hazards
- Documentation of hazards

Basic Electrical Terminology

- **Current**: the movement of electrical charge
- **Resistance**: opposition to current flow measured in ohms
- **Voltage**: a measure of electrical force
- **Conductors**: substances, such as metals, that have little resistance to electricity
- **Insulators**: substances, such as wood, rubber, glass, and bakelite, that have high resistance to electricity
- **Grounding**: a conductive connection to the earth which acts as a protective measure

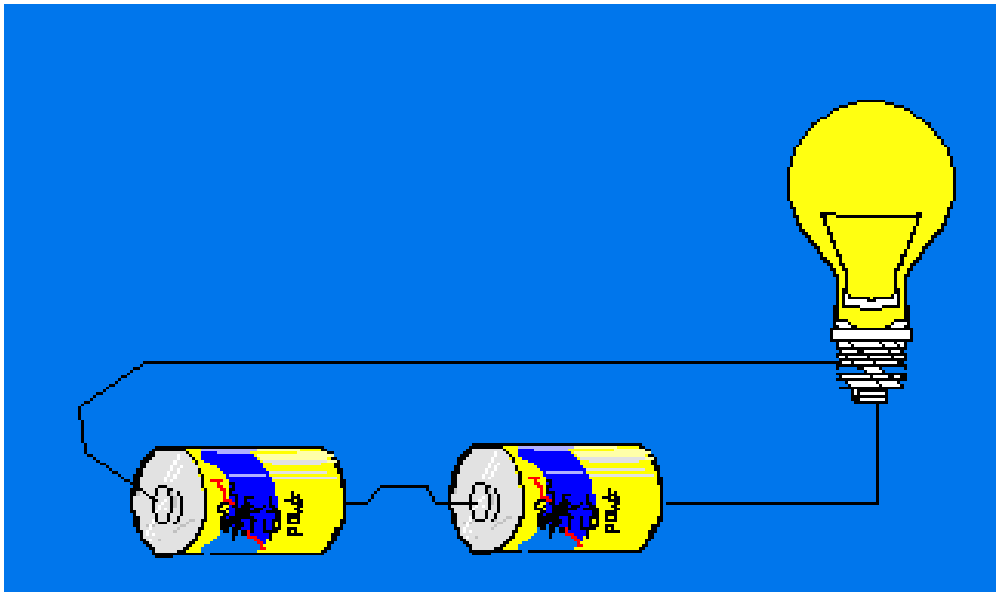
Background

- Operating an electric switch is like turning on a water faucet.

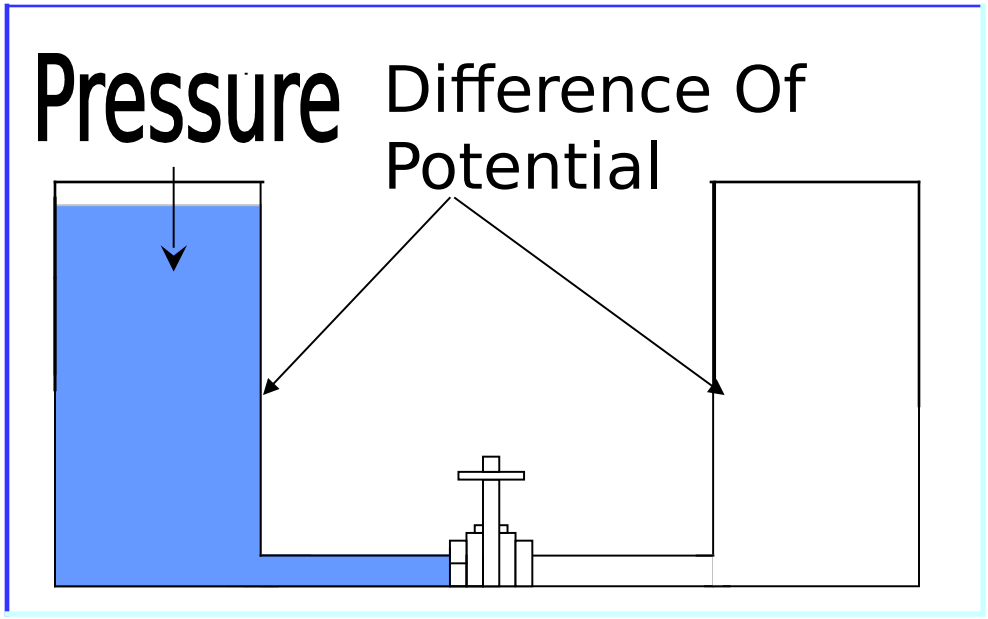
- For electricity, the source is the power generator. Current travels through electrical conductors (wires) and the force to make it flow, measured in volts, is provided by the generator.

Background cont.

VOLTAGE

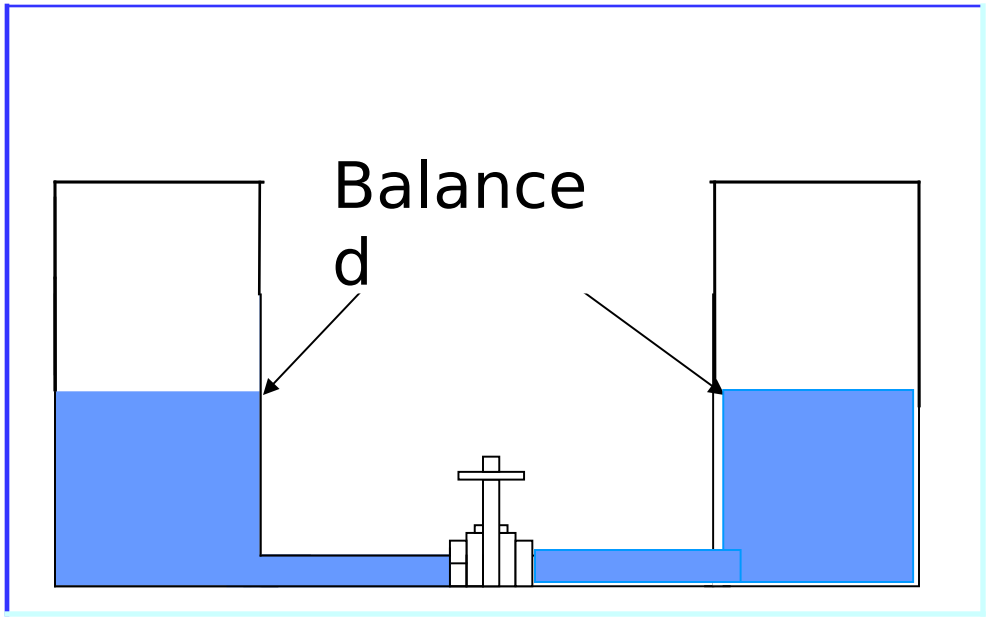


- Volt - The unit of measure of the pressure required to force one ampere through a resistance of one ohm.



- Voltage is a measurement of electrical pressure or the difference of potential.

- When the valve is open on the pipe between the tanks water will flow until both tanks are balanced.



- Voltage is a measurement of electrical pressure or the difference of potential.

- When the valve is open on the pipe between the tanks water will flow until both tanks are balanced.

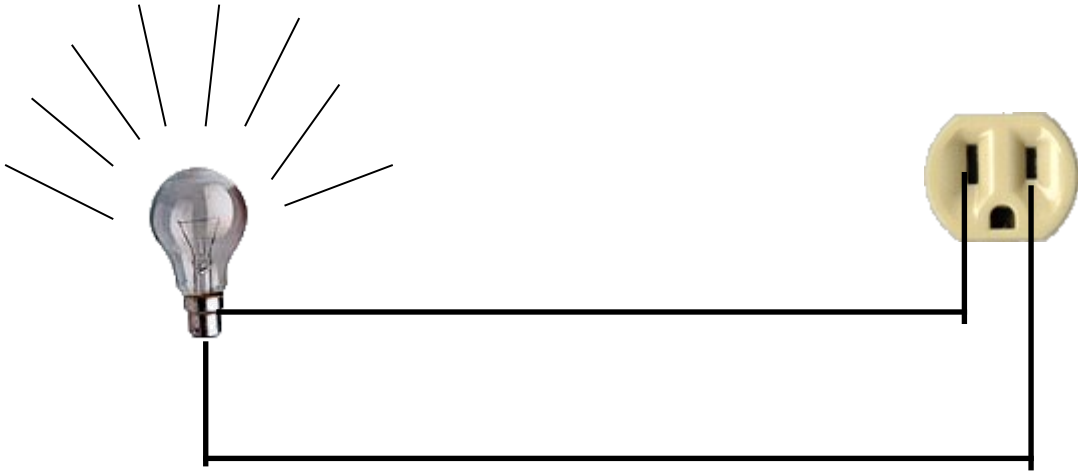
Once both tanks contain equal amounts of water, the flow of water will stop. Electricity behaves in a similar manner.

Background cont.

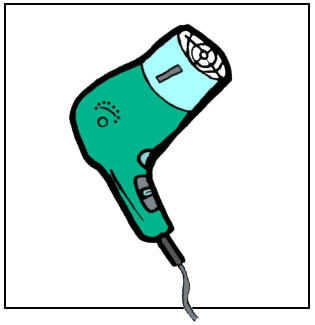
Watt:

A measure of the total energy flowing in a circuit at any given moment. A measure of electric power.

Background cont.

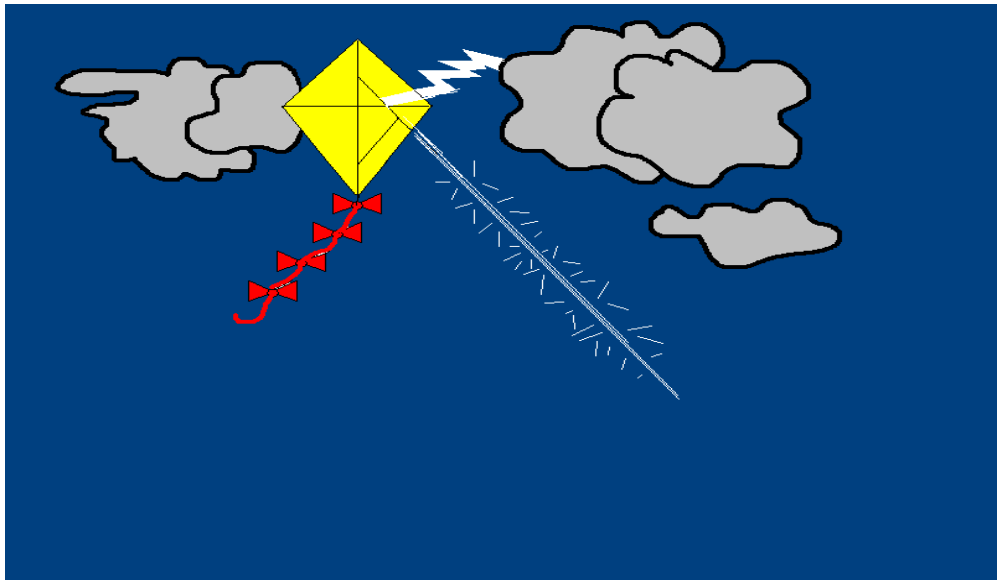


- Good example of watts as “Power” can be seen when energy is converted to heat.



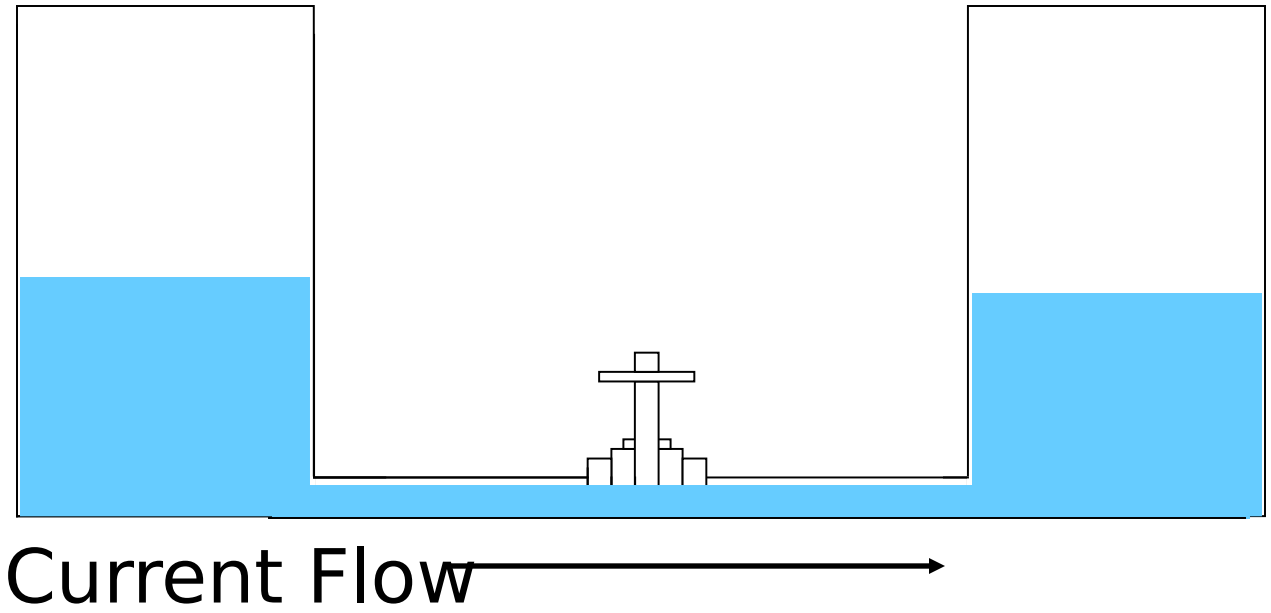
Background cont.

Amps



- Ampere - The unit of measure of electric current which will flow through one ohm under a pressure of one volt.

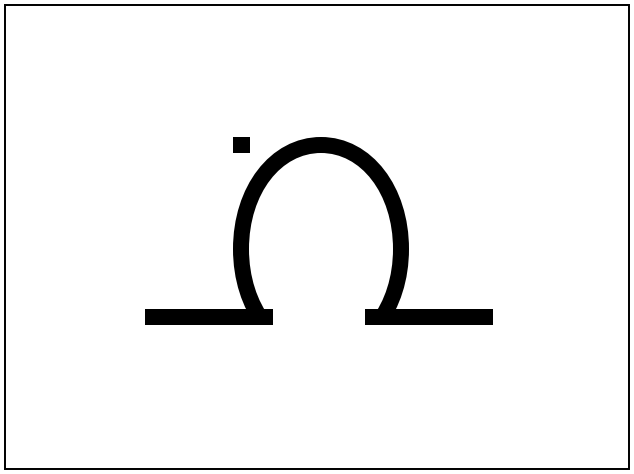
Background cont.



- Electrical current is like water flowing through a pipe
- Electrical current is measured in amperes

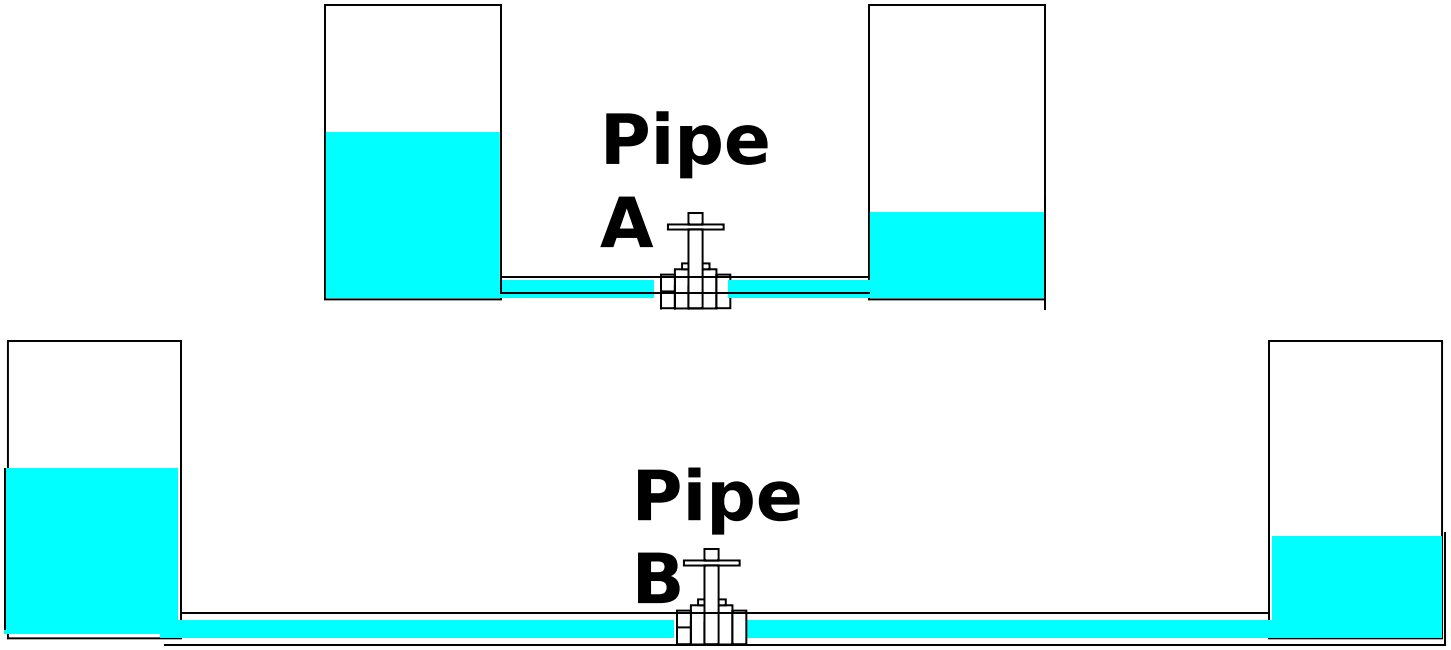
Background cont.

- Wire is a good conductor of electrical current.
- Wire offers some resistance to the flow of electrical current



- The factors that affect the resistance of the wire are:
  - The length
  - The diameter
  - The type of manufacturing material
  - The operating temperature

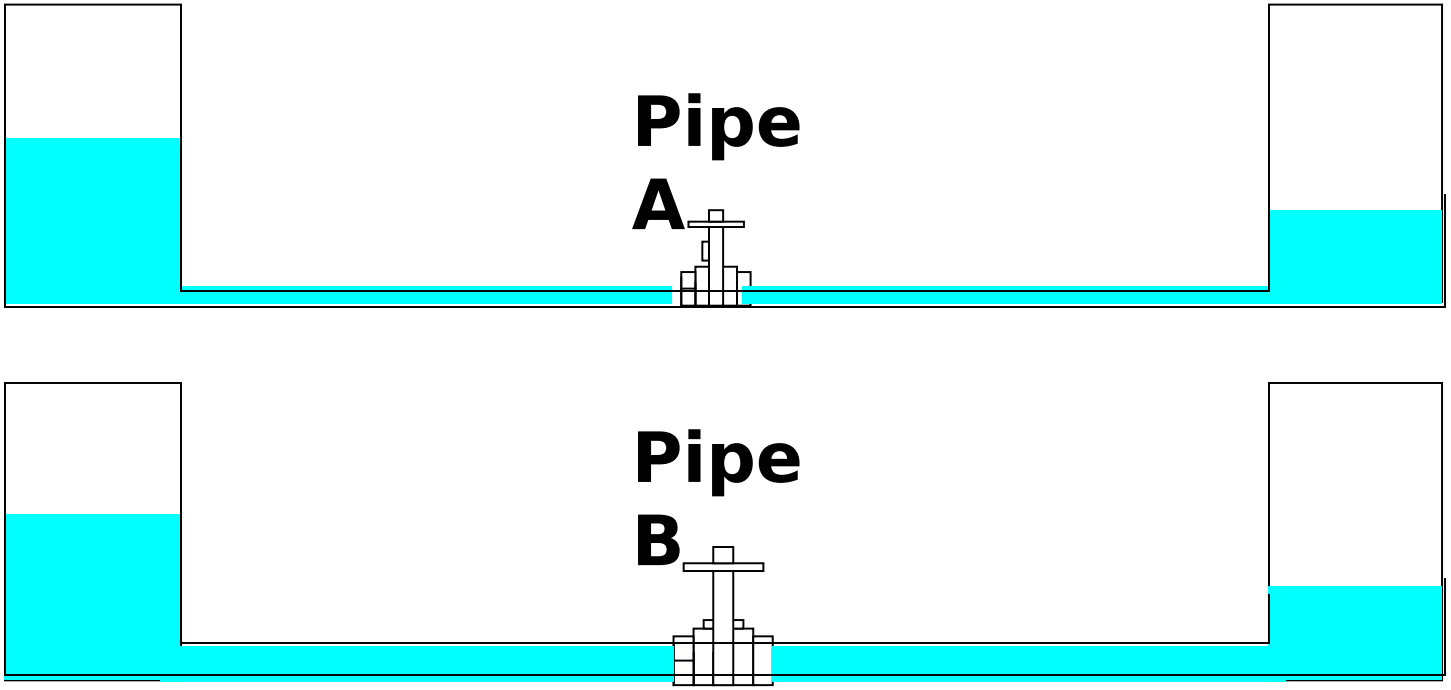
Background cont.



- Compare the sets of tanks above. Pipe “B” is longer than Pipe “A”. Pipe “B” will offer more resistance to the flow of water. This will result in a lost of pressure.

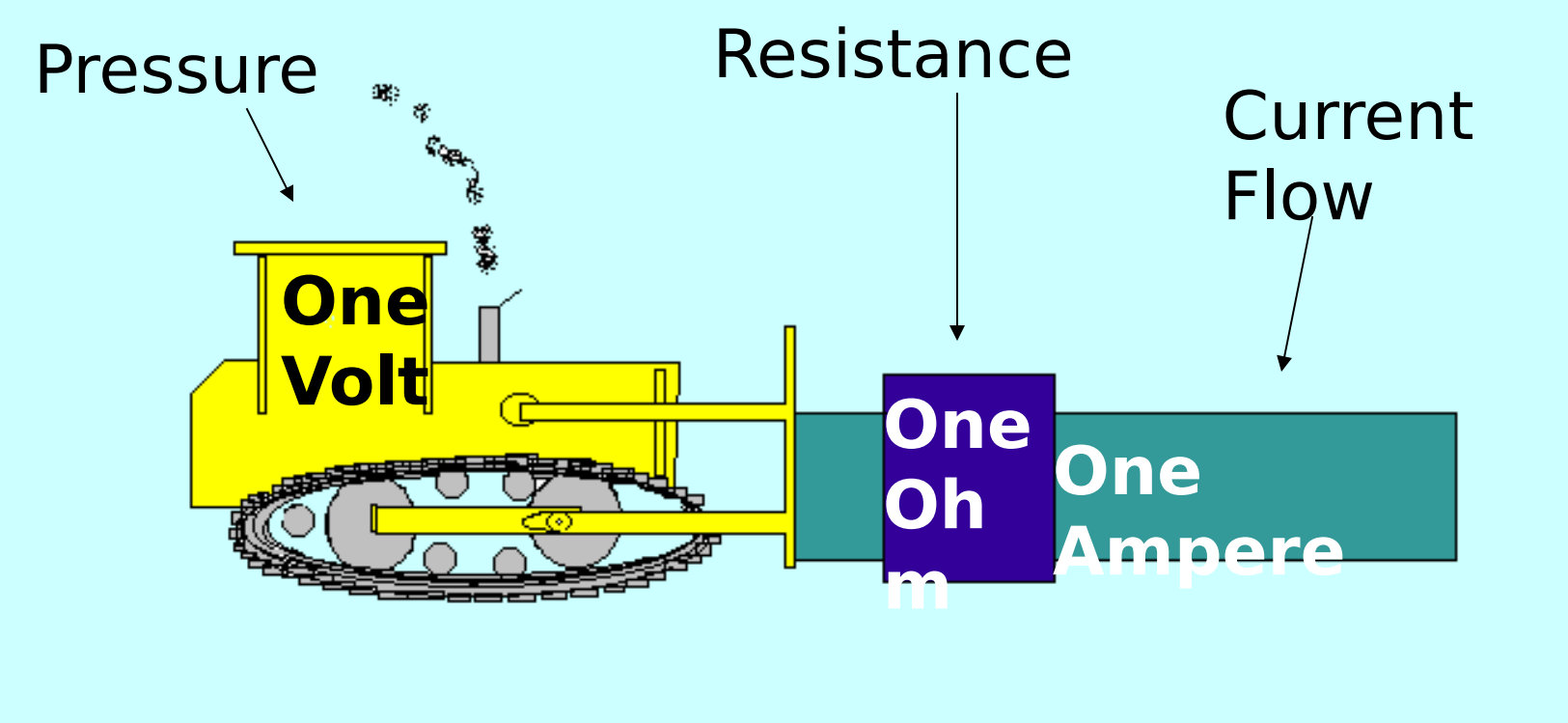
- In electricity, this is called a voltage drop.

Background cont.



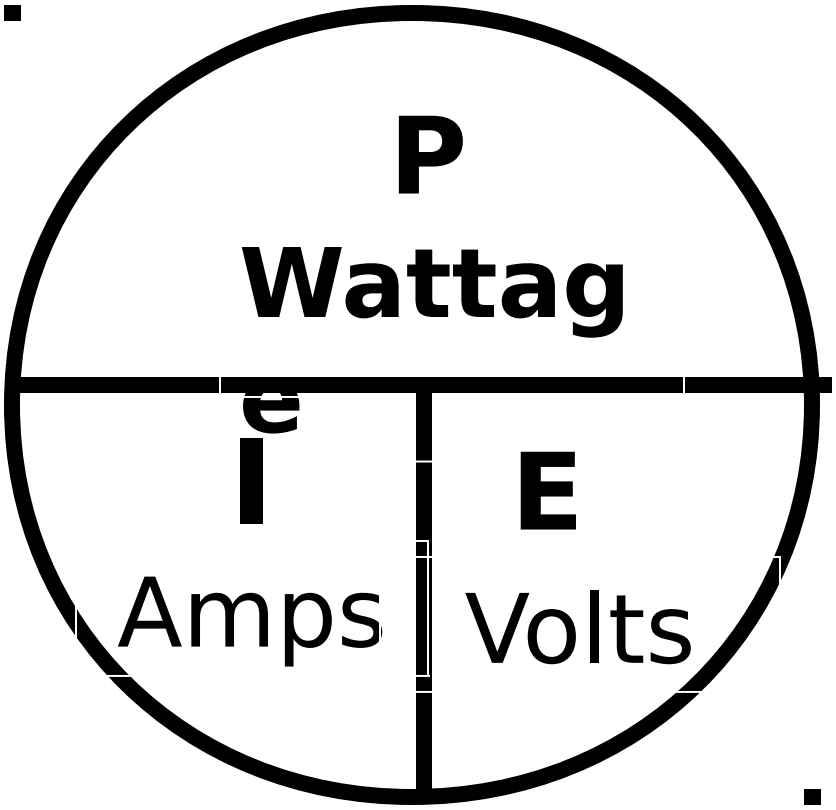
- Compare the sets of tanks above. Pipe “B” is larger than Pipe “A”. Pipe “B” will offer less resistance to the flow of water.

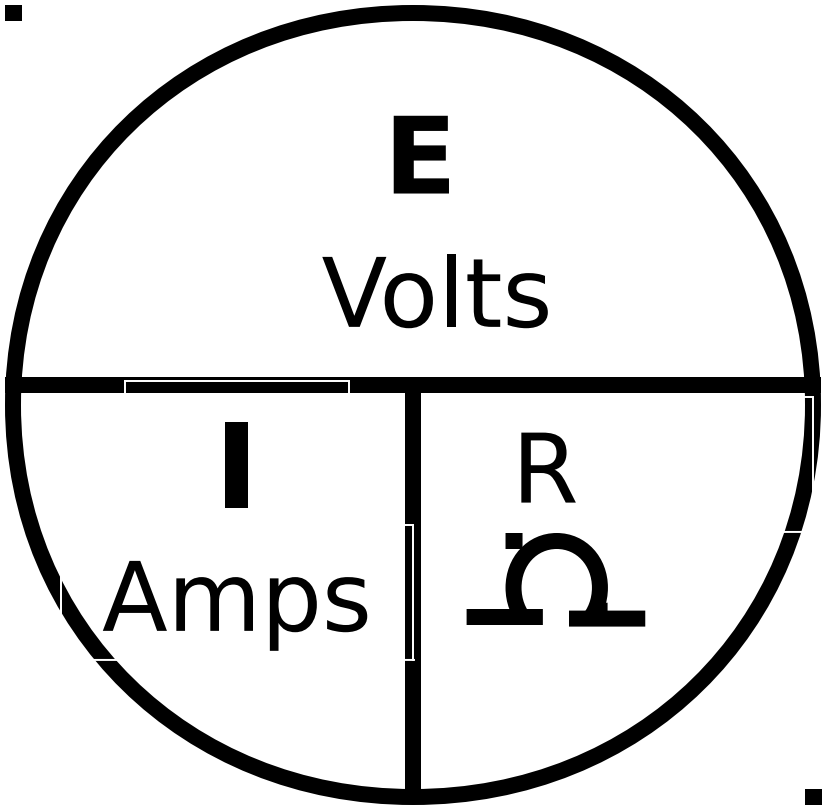
Background cont.



- Resistance is measured in ohms
- An ohm is a unit of measure of resistance through which one volt will force one ampere

Background cont.





Training (29 CFR 1910.332)

- All qualified and unqualified (electrical) workers in jobs that face the risk of electric shock that is not reduced to a safe level by the electrical insulation must receive classroom or on-the-job training in safety-related work practices that pertain to their respective job assignments
- Additional requirements for unqualified workers
  - Any electrically related safety

Training (29 CFR 1910.332) cont.

- Additional requirements for qualified workers (those permitted to work on or near exposed energized parts)
  - –The skills and techniques necessary to:
    - Distinguish exposed live parts from other parts of electrical equipment
    - Determine the nominal voltage of exposed live parts
    - Determine the clearance distances and the corresponding voltages to which they will be exposed

Describe identified hazards

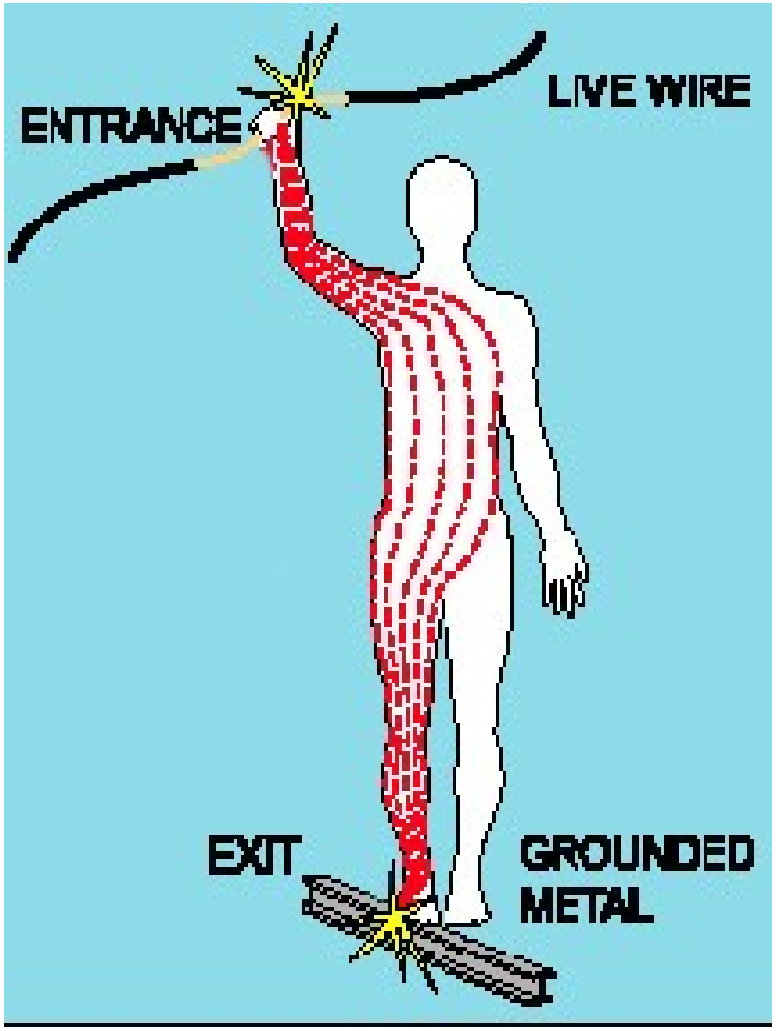
- There are four main types of electrical injuries:
  - Electrocution (death due to electrical shock)
  - Electrical shock
  - Burns
  - Falls

Describe identified hazards

- If electrocution occurs
  - Call for help
  - DO NOT touch the victim or the conductor
  - Shut off the current at the control box
  - If the shutoff is not available, use a non-conducting material to free the victim
  - If necessary and you know how, begin CPR when current is stopped
  - In dealing with electricity, never exceed your expertise

Describe identified hazards

- Electrical Shock
  - Received when current passes through the body
  - Severity of a shock depends on:
    - Path of current through the body
    - Amount of current flowing through the body
    - Length of time the body is in the circuit



Describe identified hazards

- **Dangers of Electrical Shock**
  - Currents greater than 75 mA* can cause ventricular fibrillation
  - Will cause death in a few minutes unless a defibrillator is used

Defibrillator in use

Describe identified hazards

- **Electrical Shock**
  - When two wires have different potential differences (voltages), current will flow if they are connected together
    - In most household wiring, the black wires are at 110 volts relative to ground
    - The white wires are at zero volts because they are connected to ground
  - If you come into contact with an energized (live) black wire, and you are also in contact with the white grounded wire, current will pass through your body and YOU WILL RECEIVE A SHOCK

Describe identified hazards

- **Electrical Burns**
  - Most common shock-related, nonfatal injury
  - Occurs when you touch electrical wiring or equipment that is improperly grounded
  - Very serious injury that needs immediate attention

Describe identified hazards

- **Falls**
  - Electric shock can also cause indirect or secondary injuries
  - Workers in elevated locations who experience a shock can fall, resulting in serious injury or death

Working on Energized Equipment (PPE)

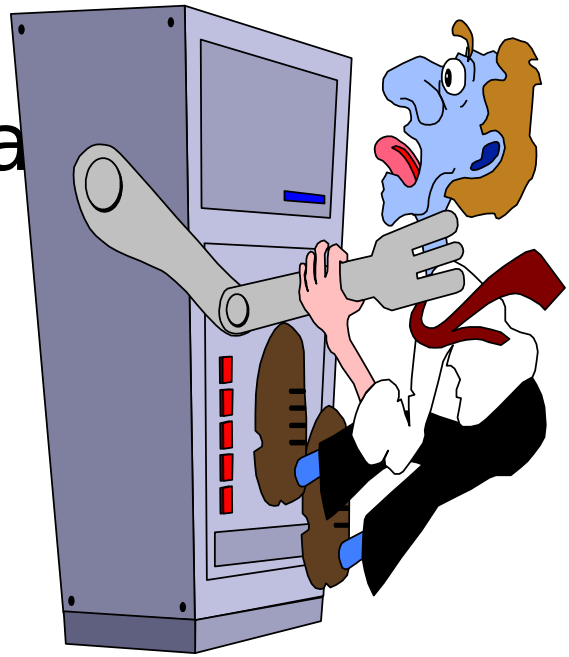
- **Energized Equipment**
  - Persons working on energized equipment must be familiar with the proper use of special precautionary techniques, PPE, insulating and shielding materials, and insulated tools

Working on Energized Equipment (PPE) cont.

- Isolate the area from all traffic
- Post signs and barricades
- Use an attendant if necessary
- Use insulated tools, mats and sheeting
- Use electrical rubber sheeting to cover nearby exposed circuits

Working on Energized Equipment (PPE) cont.

- Don’t work on energized electrical parts:
  - Without adequate illumination
  - If there is an obstruction that prevents seeing your work area
  - If you must reach blindly into areas which may contain energized parts



Working on Energized Equipment (PPE) cont.

- **PPE**
  - Must use electrical protective equipment that is appropriate for the work to be performed
  - Proper foot protection (electrical rated)
  - Rubber insulating gloves, hoods, sleeves, matting, and blankets
  - Hard hat (insulated non-conductive)

Working on Energized Equipment (PPE) cont.

- **PPE cont.**
  - Use, store, and maintain your electrical PPE in a safe and reliable condition
  - Wear non-conductive head protection
  - Wear protective equipment

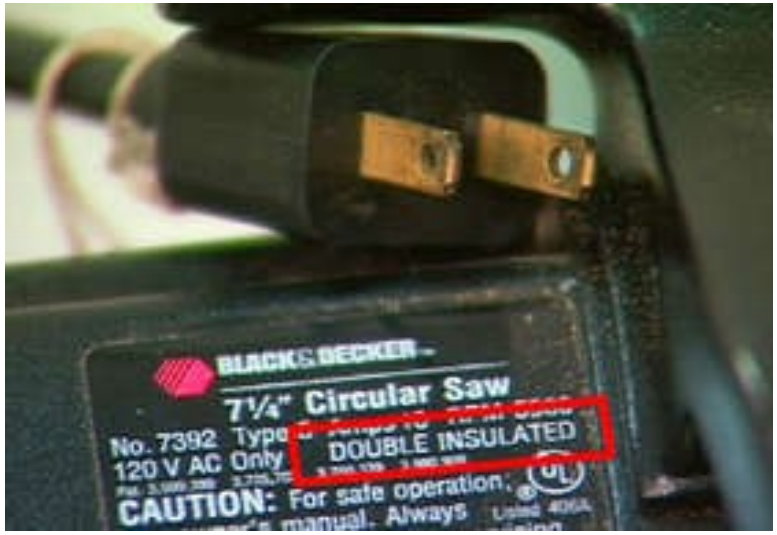
Working on Energized Equipment (Tools) cont.

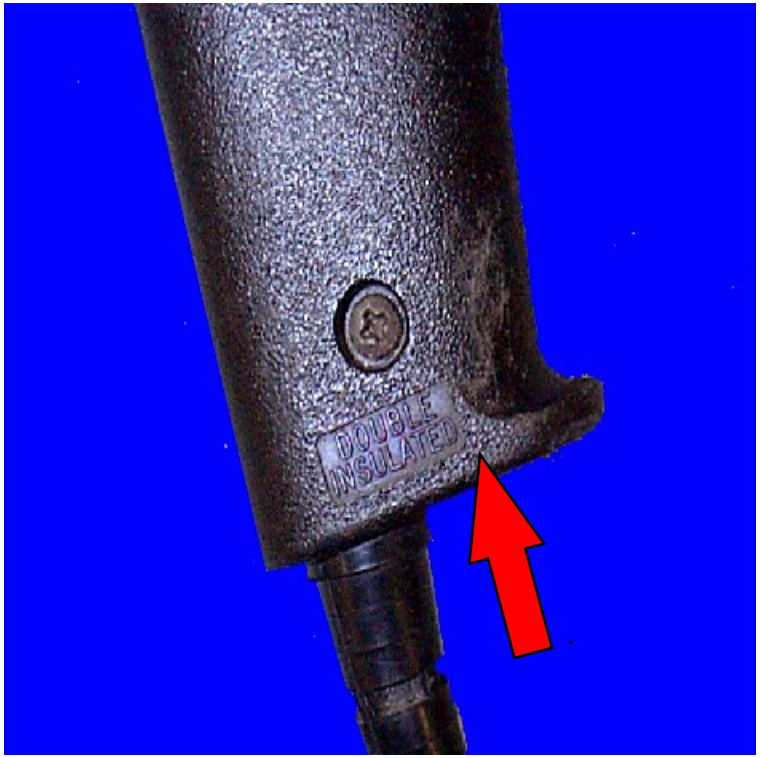
- **Hand-Held Electric Tools**
  - Pose a potential danger because they make continuous good contact with the hand
  - To protect you, tools must:
    - Have a three-wire cord with ground and be plugged into a grounded receptacle, or
    - Be double insulated, or
    - Be powered by a low-voltage isolation transformer

29 CFR 1910.304(f)(5)(v)(C)(3)

Working on Energized Equipment (Tools) cont.

- Inspect tools before use
- Use double insulated tools





Double Insulated Marking

Working on Energized Equipment (Tools) cont.

- **Tools & Equipment**
  - Ground power supply systems, electrical circuits, and electrical equipment
  - Frequently inspect electrical systems to insure path to ground is continuous
  - Don’t remove ground prongs
  - Ground exposed metal parts of equipment

Working on Energized Equipment cont.

- **Electrical Protective Devices**
  - These devices shut off electricity flow in the event of an overload or ground-fault in the circuit
  - Include fuses, circuit breakers, and ground-fault circuit-interrupters (GFCIs)
  - Fuses and circuit breakers are <u>over-current</u> devices
    - When there is too much current:
      - Fuses melt
      - Circuit breakers trip open

Working on Energized Equipment cont.

- Ground-Fault Circuit Interrupter (GFCI)
  - Detects a difference in current between the black and white circuit wires
- If a ground fault is detected, the GFCI can shut off electricity flow in as little as 1/30 of a second

Working on Energized Equipment cont.

- **Safe Work Practices**
  - Never use plugs or receptacles that can alter polarity
  - Properly plug all connecting plug-ins
  - Stay away from all unguarded conductors
  - Never overload a circuit or conductor

Working on Energized Equipment cont.

- **Safe Work Practices cont.**
  - Know where the hazards are
  - Properly maintain equipment
  - No exposed parts or energized surfaces
  - Use barriers and devices where appropriate
  - No conductors to walk on or trip on
  - No jewelry, or other metal objects around electricity

Working on Energized Equipment cont.

- Test instruments, equipment and test leads must be visually inspected for external defects and damage before the equipment is used
- Test instruments and equipment and accessories must be:
  - Rated for the circuits and equipment to which they will be connected
  - Designed for the environment in which they will be used

Identify common hazards

Identify common hazards

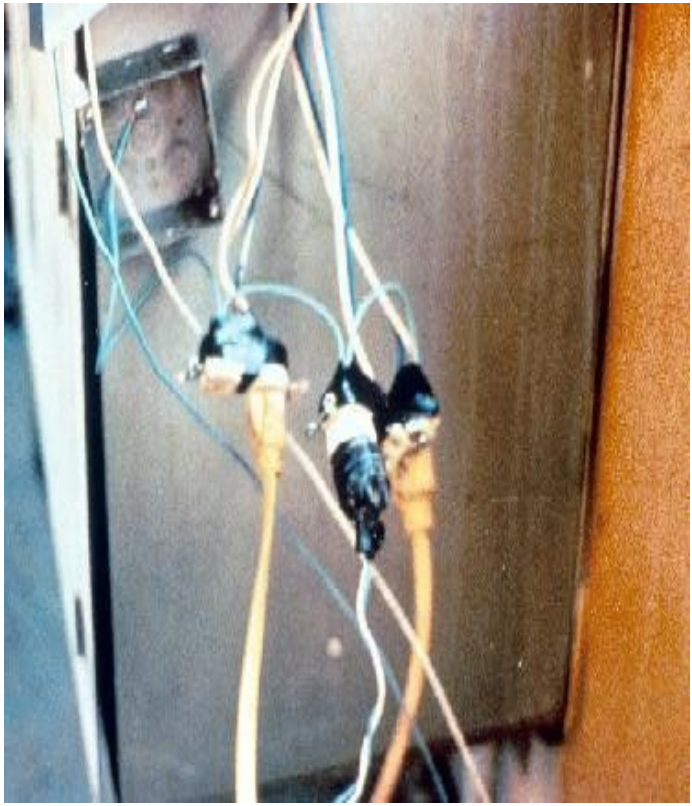
- **Effects on the Human Body**
  - 1 mA (Can be felt by the body)
  - 2-10 mA (Minor shock, might result in a fall)
  - 10-25 mA (Loss of muscle control)
  - 25-75 mA (Painful, may lead to collapse or death)
  - 75-300 mA (Last for 1 second, almost always fatal)

Identify common hazards

- **Clues that Electrical Hazards Exist**
  - Tripped circuit breakers or blown fuses
  - Warm tools, wires, cords, connections, or junction boxes
  - Worn or frayed insulation around wire or connection

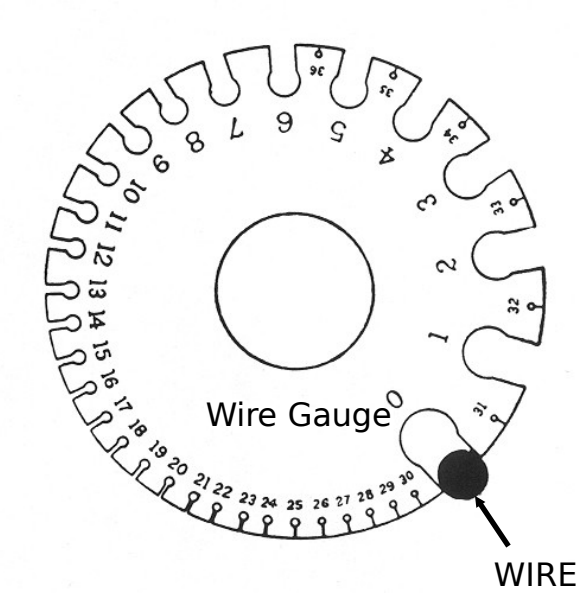
Identify common hazards

- **Controlling Electrical Hazards**
  - Most electrical mishaps are caused by a combination of three factors:
    - Unsafe work practices
    - Unsafe equipment and/or installation,
    - Workplaces made unsafe by the environment



Identify common hazards

- **Inadequate Wiring Hazards**
  - A hazard exists when a conductor is too small to safely carry the current



Wire gauge measures wires ranging in size from number 36 to 0 American wire gauge (AWG)

Identify common hazards

- **Control – Use the Correct Wire**
  - Wire used depends on operation, building materials, electrical load, and environmental factors
  - Use fixed cords rather than flexible cords
  - Use the correct extension cord

Must be 3-wire type and designed for hard or extra-hard use

Identify common hazards

- **Overload Hazards**
  - If too many devices are plugged into a circuit, the current will heat the wires to a very high temperature
  - If the wire insulation melts, arcing may occur and cause a fire, even inside a wall

Identify common hazards

- Grounding Hazards
  - Metal parts of an electrical wiring system that we touch should be at zero volts relative to ground
  - Housings of motors, appliances or tools that are plugged into improperly grounded circuits may become energized
  - If you come into contact with an improperly grounded electrical device, YOU WILL BE SHOCKED

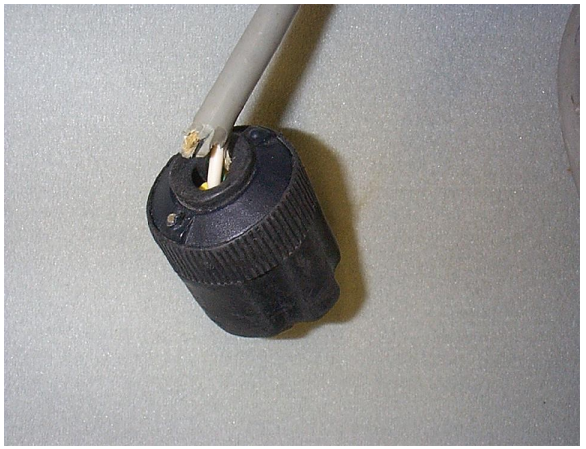
Identify common hazards

- **Grounding**
  - Grounding creates a low-resistance path from a tool to the earth to disperse unwanted current
  - When a short occurs, energy flows to the ground, protecting you from electrical shock, injury and death

GROUNDING !!!!

Identify common hazards

- **Improper Grounding**
  - Tools plugged into improperly grounded circuits may become energized
  - Broken wire or plug on extension cord
  - Some of the most frequently violated OSHA standards



Identify common hazards

- **Bonding**
  - When filling metal containers use bonding wire and keep containers closed until after bonding
  - Attach the bonding cable to a shiny metal

Identify common hazards

- **Overhead Powerline Hazards**
  - Most people don’t realize that overhead powerlines are usually not insulated
  - Powerline workers need special training and personal protective equipment (PPE) to work safely
  - Beware of powerlines when you work in the vicinity with ladders, erecting antennas, moving equipment, etc.

Identify common hazards

- **Insulation**
  - Check insulation prior to using tools and equipment
  - Remove from service any tools or equipment with damaged insulation

Identify common hazards

- **Guarding of Live Parts**
  - Must guard live parts of electric equipment operating at 50 volts or more against accidental contact

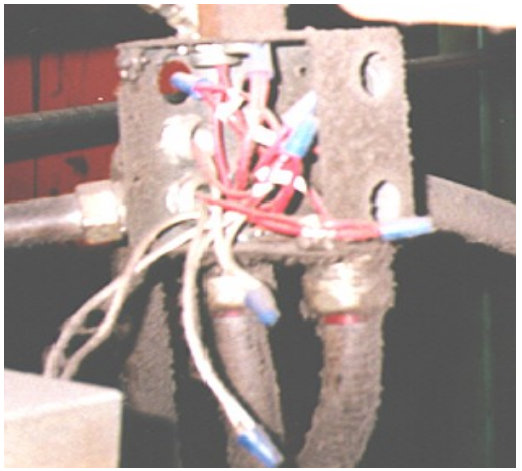
Mark entrances to guarded locations with conspicuous warning signs

Identify common hazards

- **Guarding of Live Parts cont.**
  - Must enclose or guard electric equipment in locations where it would be exposed to physical damage

Identify common hazards

- **Cabinets, Boxes, and Fittings**
  - Junction boxes, pull boxes and fittings must have approved covers
  - Unused openings in cabinets, boxes and fittings must be closed



Identify common hazards

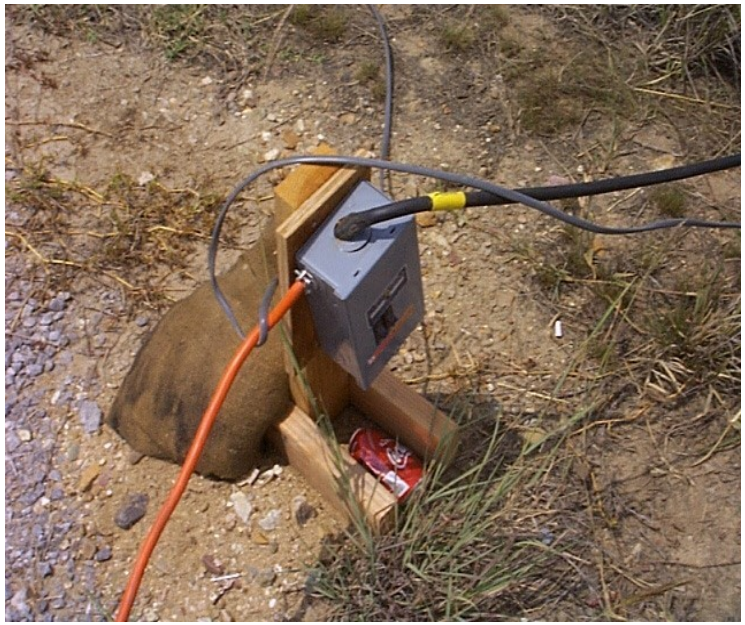
- **Warn Others**
  - Use barricades to prevent or limit access to work areas
  - If signs and barricades do not provide sufficient warning and protection from electrical hazards, an attendant shall be stationed to warn and protect employees
  - Use safety signs, safety symbols, or accident prevention tags to warn others about electrical hazards

Identify common hazards

- **Visually Inspect**
  - Portable cord and plug connected equipment and flexible cord sets (extension cords) shall be visually inspected before use on any shift for external defects
  - If there is a defect or evidence of damage to any electrical tools or equipment
    - Immediately notify your supervisor
    - Remove the item from service
    - Tell your co-workers

Identify common hazards

- **Conductive Work Locations**
  - Portable electric equipment & flexible cords used in highly conductive (wet) work locations, where workers are likely to contact water or conductive liquids, must be rated for the wet environment



Identify common hazards

- **Use of Flexible Cords**
  - More vulnerable than fixed wiring
  - Flexible cords can be damaged by:
    - Aging
    - Door or window edges
    - Staples or fastenings
    - Abrasion from adjacent materials
  - Improper use of flexible cords can cause shocks, burns or fire

29 CFR 1910.305(g)

Identify common hazards

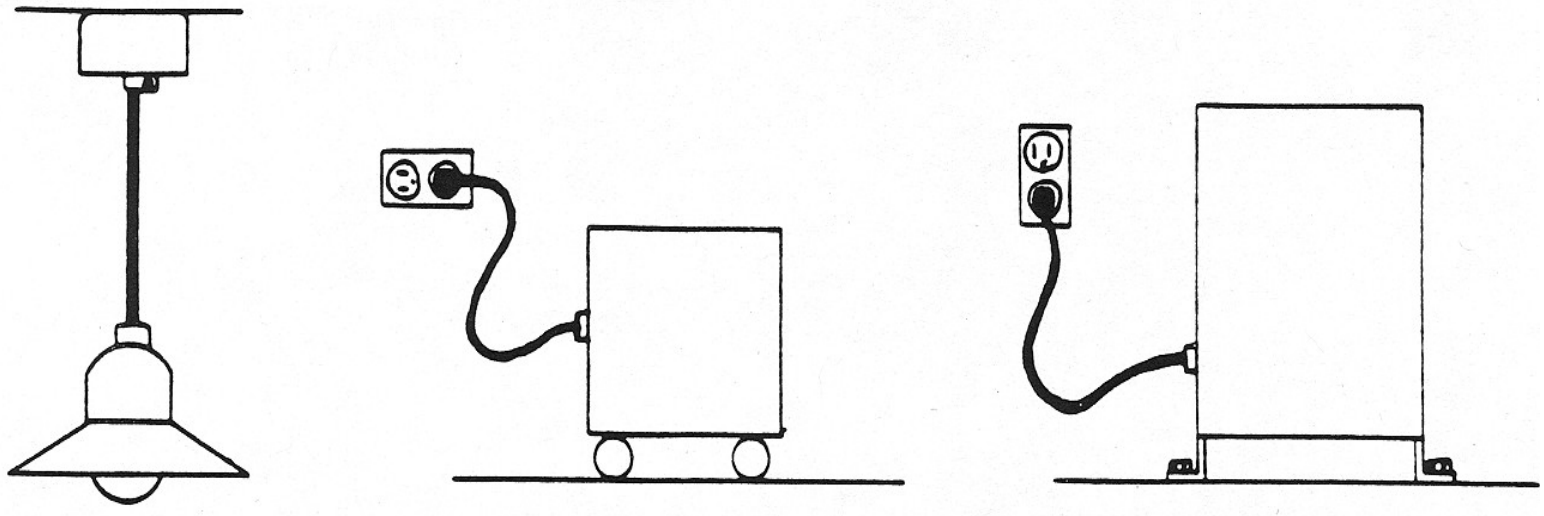
- **Working Safe with Cords**
  - Cords should be kept clean and free of kinks and insulation breaks
  - Cords crossing vehicular or personnel passageways should be protected
  - Cords should be of continuous length and without splices

Identify common hazards

- **Working Safe with Cords cont.**
  - Two or more extension cords plugged together are illegal
  - Prevent strain on plug or receptacle

Permissible Uses of Flexible Cords

Examples



Pendant, or Fixture Wiring

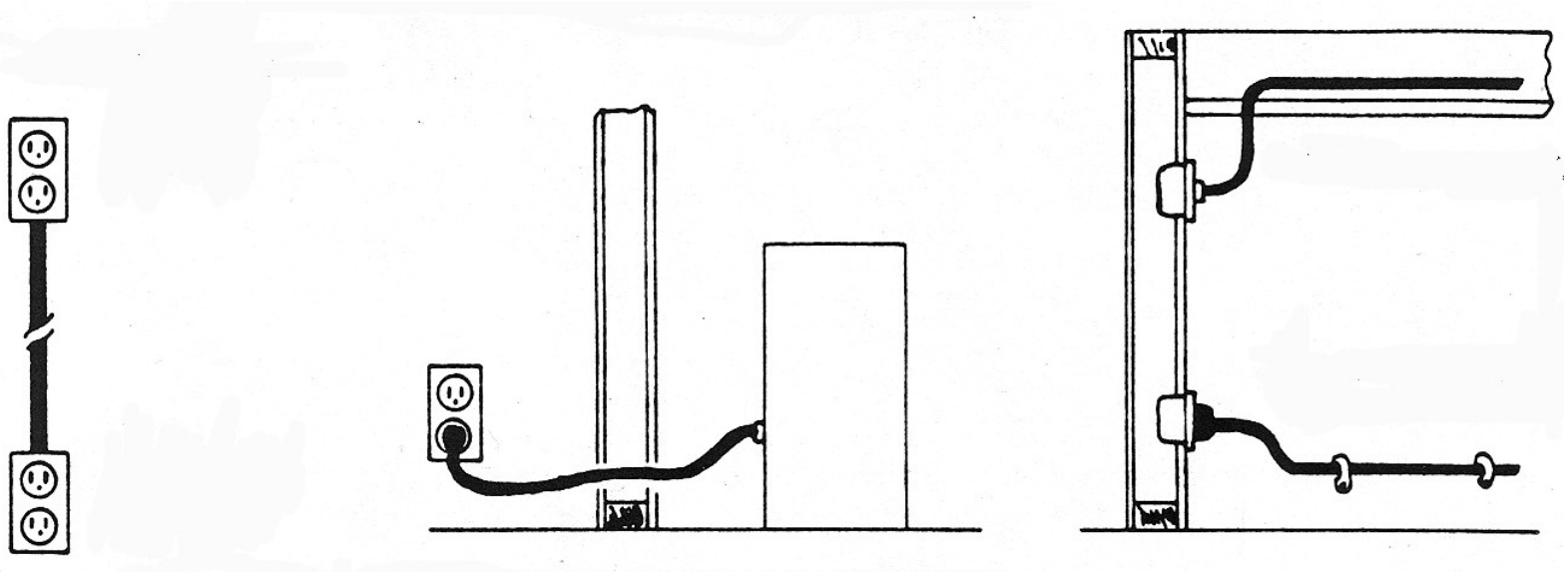
Portable lamps, tools or appliances

Stationary equipment-to facilitate interchange

1910.305(g)(1)(i)

Prohibited Uses of Flexible Cords

Examples



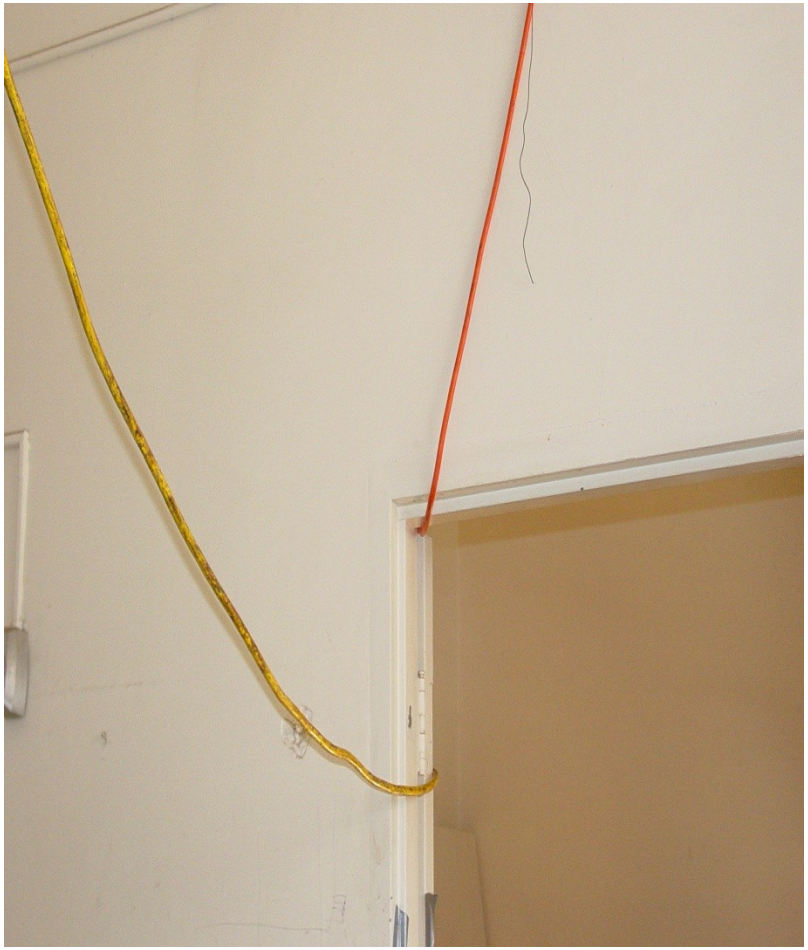
Substitute for fixed wiring

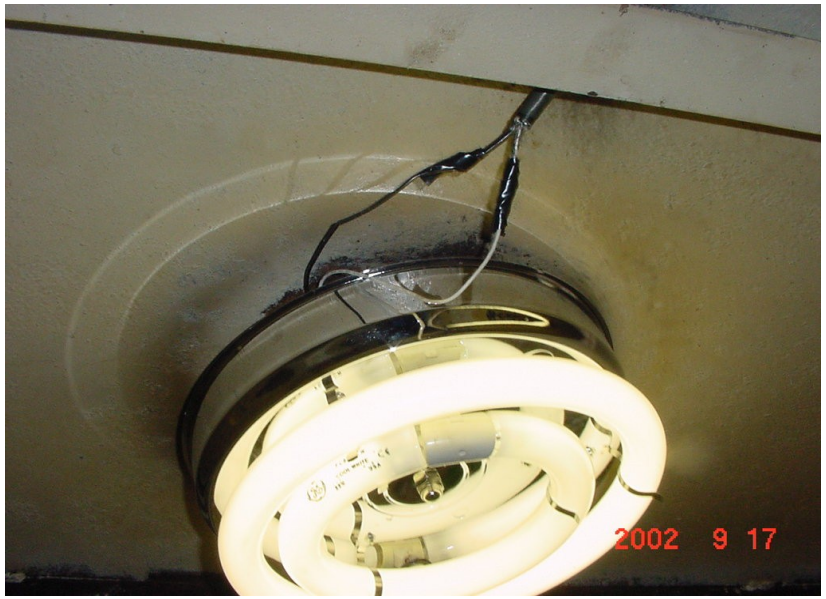
Run through walls, ceilings, floors, doors, or windows

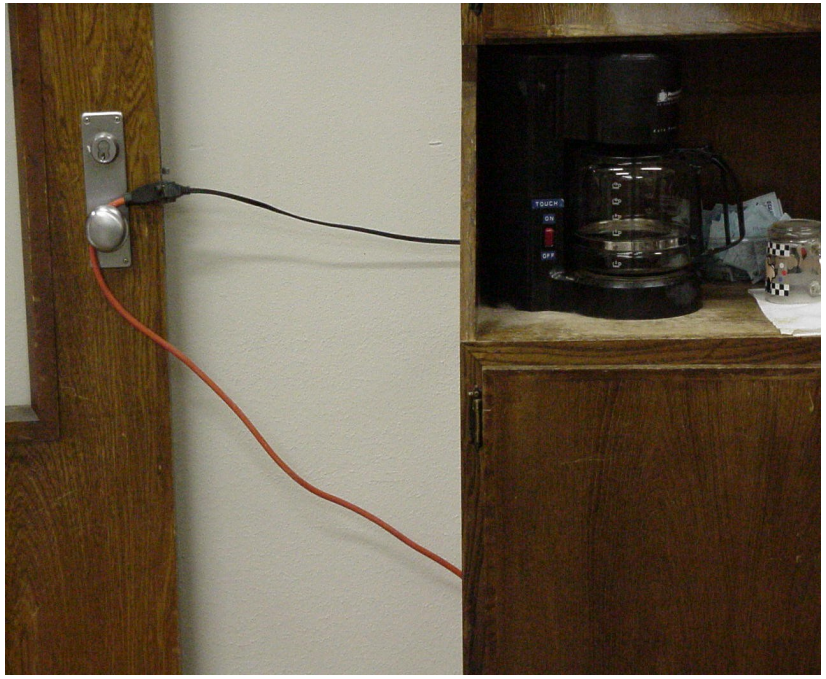
Concealed behind or attached to building surfaces

1910.305(g)(1)(iii)

What's the hazard?

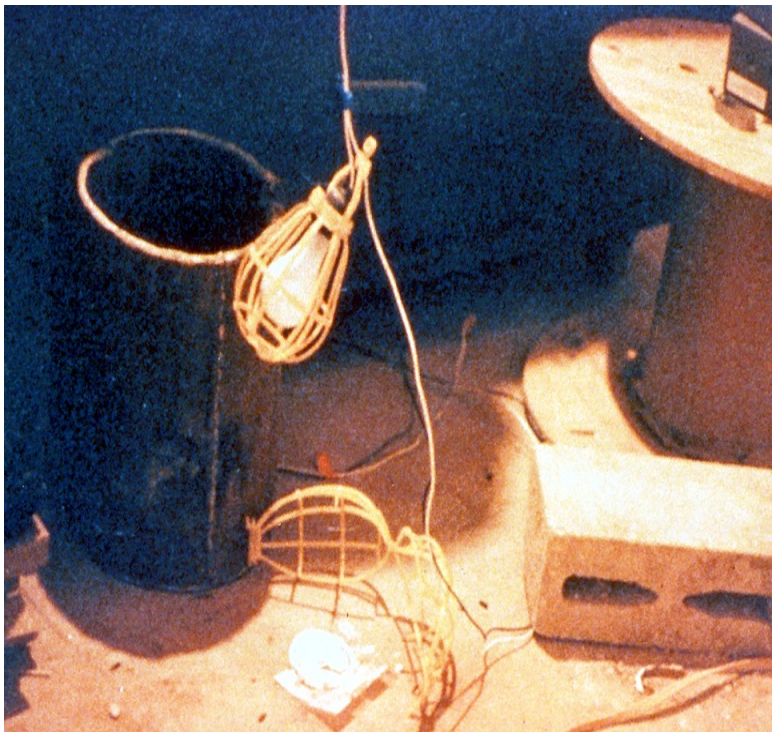






Identify common hazards

- **Temporary Lights**
  - Protect from contact and damage, do not suspend by the cord unless designed to operate that way



Identify common hazards

- **Panel Boxes**
  - Used to house circuit breakers that block or isolate energy
    - Ensure panel boxes remain clear
    - Label all circuits for what they control
    - Label panel boxes for what they control
    - Replace circuit breakers with blanks when not in use

Submit Work Requests

- Per installation’s regulations concerning facility maintenance work request submission system
  - Ensure priority is identified
  - Ensure follow-ups are conducted routinely

Documentation of hazards

- In accordance with applicable references
- Utilization of Hazard Abatement Log
  - Should be maintained by safety officer
- Upon completion of facility inspection, conduct after-action brief with appropriate command personnel

References

- NAVMC DIR 5100.8 Chapter 12 (LOTO)
- 29 CFR 1910 Subpart S
- 29 CFR 1926
- NFPA 70 National Electrical Code

Final Advice

Treat electricity with the respect it demands, and it will serve you efficiently and effectively


MCB CAMP LEJEUNE
BASE
CAMP LEJEUNE
SAFETY
SEMPER SAFE